

MECHATRONICS BOOK SERIES

CONTROL AND INTELLIGENT SYSTEMS

Momoh Jimoh E. Salami
Abiodun Musa Aibinu
Yasir Mohd Mustafah



IIUM Press

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

MECHATRONICS BOOK SERIES

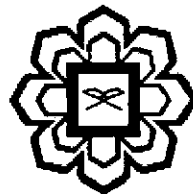
CONTROL AND INTELLIGENT SYSTEMS

EDITOR

Momoh Jimoh E. Salami

Abiodun Musa Aibinu

Yasir Mohd Mustafah



IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Momoh Jimoh E. Salami, Abiodun Musa Aibinu, Yasir Mohd Mustafah: Mechatronics Book
Series: Control and Intelligent Systems

Bibliography p.
Includes Index
ISBN

ISBN: 978-967-418-176-5

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

Table of Content

PREFACE.....	v
EDITOR.....	vi
SECTION 1: INTELLIGENT CONTROL SYSTEM	5
Chapter 1	6
Working Principle and Operating Mode of Atomic Force Microscopy	
Iskandar Al-Thani Mahmood	
Chapter 2	13
Design and Development of controller of Active Power Filter for Industrial Usage part 1	
M.M.Rashid ¹ , N.A.Ramin ² and Zahurul ²	
Chapter 3	21
Design and Development of controller of Active Power Filter for Industrial Usage part 2	
M.M.Rashid ¹ , N.A.Ramin ² and Zahurul ²	
Chapter 4	30
Design and Implementation of Instant Noodles Vending Machine	
M.M.Rashid	
Chapter 5	39
Development of Intelligent Belt Conveyor System (Part 1)	
M. M. Rashid, Faruok Alliays	
Chapter 6	45
Development of Intelligent Belt Conveyor System	
M.M.Rashid, Faruk, M J E Salami	
Chapter 7	50
Anti Skid Control System, A Tutorial	
M. J. E. Salami, A. M. Aibinu, A. F. Salami and Mohd Sofian Bin Basrah	
Chapter 8	54
Design and Prototyping of Inertia Wheel	
W. Astuti, A. R. Kasim, M. I. Solihin, A.M. Aibinu, Momoh Jimoh E.Salami and Wahyudi	
Chapter 9	62
Control of Automatic Drilling Machine by PLC	
Md Mozasser Rahman, Najiah Md Zain @Abdul Rahman and Mohd Syazwan Bin Jamil	
Chapter 10	74
Automatic Storage and Retrieval System	
Abdul Kadir Abdul Jabar Abdul Kadir, M. J. E. Salami and A. M. Aibinu	
Chapter 11	80
Control of Unmanned Underwater Vehicle	
Raisuddin Khan ^{1,a} , Faried Hasbullah ^{2,b} and Masum Billah ^{3,c}	
Chapter 12	85

Adaptive Sliding Mode Control for 3dof Helicopter Mostafa A. Hamood ^a , Rini Akmeliawati ^b	
Chapter 13	93
Backstepping Control of an Autonomous Quadrotor Norafizah Abas ¹ , Rini Akmeliawati ²	
Chapter 14	103
Piezoelectric Tube Scanner in Atomic Force Microscope Iskandar Al-Thani Mahmood	
SECTION II : INTELLIGENT CONTROL SYSTEM DESIGN	111
Chapter 15	112
A Review on Control of Two-Wheeled Wheelchair System Salmiah Ahmad ^{1, a} , M. O. Tokhi ^{2, b}	
Chapter 16	121
A Smart Car Surveillance System using Programmable Logic Controller (PLC) Siti Fauziah Tohaa and Mohammad Zafran Haja Mohideen	
Chapter 17	128
Design of Controller for Elevator Group Using Fuzzy Logic Part 1 M.M.Rashid, Azhar	
Chapter 18	133
Design of Controller for Elevator Group Using Fuzzy Logic Controller Part 2 M.M.Rashid, Azhar	
Chapter 19	139
Fuzzy Logic-based Intelligent Control of Flexible Link Manipulator Ismaila B. Tijani and Rini Akmeliawati	
Chapter 20	148
EEG based robot control A. Khorshidtalab and M. J. E. Salami	
Chapter 21	158
Visual-Based Intelligent Solar Tracking System Rini Akmeliawati*, Samir A. Abdul Kareem, Riza Muhida	
SECTION III: INTELLIGENT SYSTEM DESIGN	172
Chapter 22	173
Intelligent Air-conditioning System Amir A. Shafie, Raisuddin Khan, H. Al-haieaid M. Ebrahim	
Chapter 23	179
An Intelligent Car Surveillance System: Design and Tools Selection Siti Fauziah Toha ^a and Mohammad Zafran Haja Mohideen	
Chapter 24	185
Automatic Pipe Bursting Monitoring System M. J. E Salami, Syed Ahmed @ Hla Moe Win	

Chapter 25	194
Development of an Intelligent Laundry System	
Mohd Hafizi Azmi, Muhammad R. Affendy, M. J. E Salami and A.M. Aibinu	
Chapter 26	203
Development of Palmprint based Biometric System	
M. A. Rotinwa-Akinbile, A.M. Aibinu and M. J. E. Salami	
Chapter 27	213
Development of Smart Baby Chair	
M. J. E Salami, Fatanah M.S. and Fadiah Bt Ismail	
Chapter 28	219
Intelligent Automatic Fruit Identification System	
M. Aibinu, M. J. E. Salami, N. Hazali, N. Termidzi , and A. A. Shafie	
Chapter 29	229
Intelligent SCADA-Based Telemetry System for Monitoring and Controlling of Municipal Sewage Treatment Plant: IIUM, Gombak As a Case Study	
Momoh-J.E Salami. Abdulghafur A., Muhamad F. Sainal and Nasrodin T.. Mustapha. Ismaila B. Tijani	
Chapter 30	238
Development of Prototype Real-time system for SCADA-based Monitoring and Controlling System for Sewage Treatment Plant	
Momoh-J.E Salami, Abdulghafur A., Muhamad F. Sainal and Nasrodin T.. Mustapha. Ismaila B. Tijani	
Chapter 31	250
Intelligent Water Heater System	
M. J. E Salami and Khairul Ikram Bin Kamarul Bahrin	
Chapter 32	255
Machine Intelligence: MIQ, MSQ, and MEQ	
Nahrul Khair Alang Md Rashid and Khairul Affendy Md Nor	
Chapter 33	260
Coil Windings Determination Using Genetic Algorithm	
Abiodun Musa Aibinu. M. J. E Salami and Hafsat Farooqi	
Chapter 34	264
Determination of Material Depth Using Artificial Neural Network	
Aalya Banu, Sharmila Fathima and Nahrul Khair Alang Rashid	
Chapter 35	278
Design of Ink Refilling Machine For Marker Pen	
A. M. Aibinu, Rusnajaa Binti Mohd Yusoff And Liyana Bte Sani	
SECTION IV : MODELLING AND SIMULATION.....	283
Chapter 36.....	284
Hajj Crowd Simulation Based on Intelligent Agent	
Teddy Surya Gunawan ^{1,a} , Mira Kartiwi ^{2,b} , Willy Wahyu Mulyana ^{3,c}	

Chapter 37	292
Kernel PCA – An Introduction	
Hamza Baali ^{1,a} , Momoh-Jimoh Eyiomika Salami ^{2,b} , Rini Akmeliawati ^{3,c}	
Chapter 38	297
System Modelling of a Twin rotor System: Time and Frequency Domain Analysis	
Siti Fauziah Toha ^{1,a} and M. O. Tokhi ^{2,b}	
Chapter 39	304
System Identification Technique for a Helicopter Using Genetic Algorithms	
Siti Fauziah Toha ^{1,a} and M. O. Tokhi ^{2,b}	
Chapter 40	311
Advanced Noise Removal Techniques for the Detection of EMG Signal	
Md. Rezwanul Ahsan ^{1,a} , Muhammad Ibn Ibrahimy ^{2,b} and Othman Omran Khalifa ^{3,c}	
Chapter 41	322
Active suspension system: Part 1 - Mathematical Modelling	
Aiman O. Bajaber ^a , Asan G. A. Muthalif ^b , Ayman S.I. Elzubair ^c	
Chapter 42	327
Active Suspension System: Part 2 - Controller Design and Simulation	
Ayman S.I. Elzubair ^a , Asan G. A. Muthalif ^b , Aiman O. Bajaber ^c	
Chapter 43	332
Book Shelving Robotics	
M. J. E. Salami ^{1,a} , Mohd Farid Md Alias ^{2,b} , Nurul Izzah Sidek ^{3,c} , Mohamed Mousa ^{4,d}	
Chapter 44	337
Model Structure and Random Input for System Identification Technique for Flexible Manipulating System	
Siti Fauziah Toha ^{1,a} and M. O. Tokhi ^{2,b}	
Chapter 45	344
Fault Tree Analysis, A case study of a simple Line Following Robot	
Abiodun Musa Aibinu, Haaris Ahmad Quadri, Mu Ilam Mach A Mine, Almehmadi Tarig Saeed S And Hamide Rohimah	
Chapter 46	351
Review of Malaysian Traffic Summon and Payment system	
A. M. Aibinu, Sharifah Nadiyah bt Syed Mohammad, Wan Nur Faezah bin Wan Azmi	

Chapter 44

Model Structure and Random Input for System Identification Technique for Flexible Manipulating System

Siti Fauziah Toha^{1,a} and M. O. Tokhi^{2,b}

¹Department of Mechatronics, Faculty of Engineering
International Islamic University Malaysia, Malaysia

²Department of Automatic Control and Systems Engineering
Mappin Street, University of Sheffield, United Kingdom

^atsfauziah@iium.edu.my, ^bo.tokhi@sheffield.ac.uk

44.1 Parametric Modeling

Parametric models are described by using a model structure and a finite number of parameters which relate the relevant system signals (input, output and disturbances) [1]. These models are described in the discrete time domain, since the identification process is based on experimental data obtained through sampling. In case a continuous model is required, it is possible to convert the model from discrete to continuous time domain. The process of system identification technique for model estimation that characterises the behaviour of a dynamic system can be summarised in four steps, as shown in Figure 44.1.

Model structure selection constitutes one of the most important and difficult decisions that have to be made within the system identification procedure, since model complexity can affect the exactitude at which the model describes the real process [1]. Structure selection means to determine appropriate polynomials that will constitute the model framework. To find the best model implies choosing a convenient structure as well as an adequate number of parameters [2].

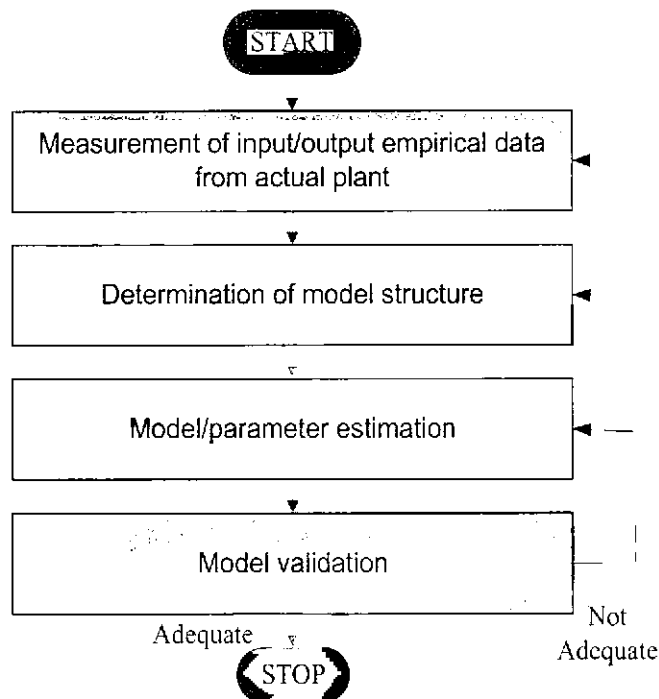


Figure 44.1: System identification procedure